

15501, 15511 and 15531

Soils

140, 275.8 and 291.7grams

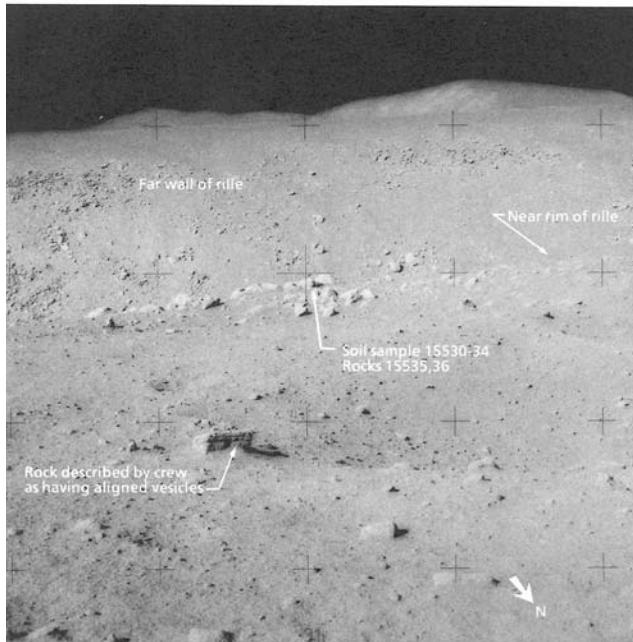


Figure 1: Tele-photo of edge of Hadley Rille where 15531 was taken. 15501 and 15511 were from the foreground. AS15-82-11126.

Modal content of soil 15501 and 15531.

From Basu et al. 1981.

	15501	15531
Agglutinates	35.1%	23.7
Mare Basalt	7.7	15.8
KREEP basalt	1.3	0.8
Breccia	13.1	3.9
Anorthosite	0.4	0.1
Norite		
Gabbro	0.3	0.6
Plagioclase	6.6	7.2
Pyroxene	18.6	30.1
Olivine	2.7	5.3
Ilmenite	0.3	0.9
Glass other	11.3	7.1

From Carr and Meyer 1974

Agglutinates	56.9%	25.6
Basalt	6.9	22.4
Breccia	1.6	0.6
Plagioclase	6	8
Pyroxene	16	34.9
Olivine	2.6	1.2
Ilmenite	0.2	0.6
Glass other	9.8	6.7

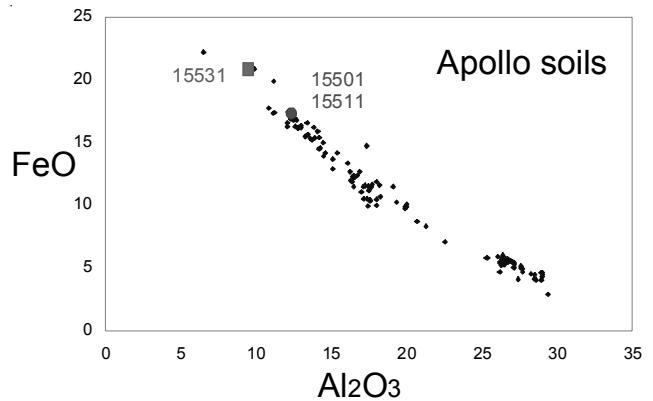


Figure 2: Chemical composition of 15501 and 15531 compared with that of other Apollo soils.

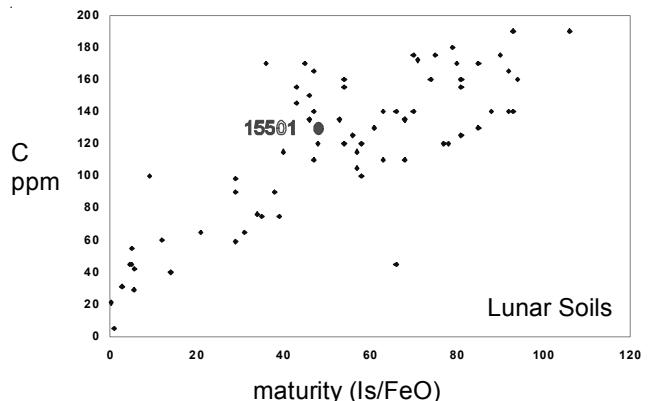


Figure 3: Maturity index and carbon content of 15501.

Introduction

15501 and 15511 were collected from the rim of a small crater at station 9, while 15531 was collected at station 9a (near Hadley Rille). 15501 is the < 1 mm soil that came with 15505 (a large breccias), 15511 is the soil that came with the rake sample, and double drive tube 15011/10 was collected near 15531 and 15600 (rake).

Petrography

The maturity index (I_s/FeO) of 15501 is 51 (submature) and that of 15531 is 27 (immature) (Morris 1978). Carr and Meyer (1974) and Basu et al. (1981) determined the mineralogic mode for 15501 and 15531. There were ~57% agglutinates in 15501 while 15531, from near the Rille, only had about 25% agglutinates.

Powell (1972) and Ryder and Sherman (1989) cataloged the coarse-fines.

Chemistry

The chemical composition is plotted in figures 2 and 4.

The carbon content of 15501 is 110 or 130 ppm (Cadogen 1972 or Moore et al. 1973)(figure 3).

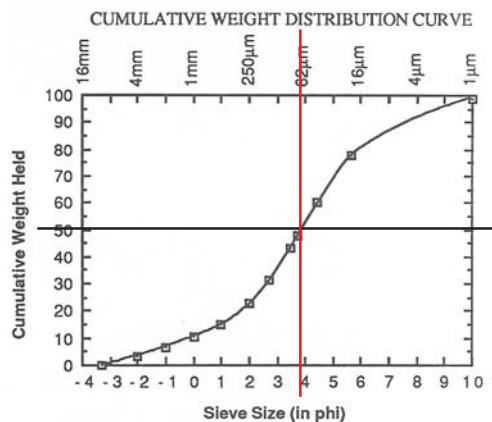
Walker and Papike (1981) calculated that 15501 – 15511 was composed of about 60 % mare basalt, 20 % KREEP and 5 % green glass.

Radiogenic age dating

Alexander et al. (1976) produced an isochron (figure 6), but it has no real meaning.

Cosmogenic isotopes and exposure ages

Rancitelli et al. (1972) determined the cosmic-ray-induced activity of ^{22}Na = 62 dpm/kg, ^{26}Al = 74 dpm/kg and ^{46}Sc = 7 dpm/kg.



Average grain size = 69 microns

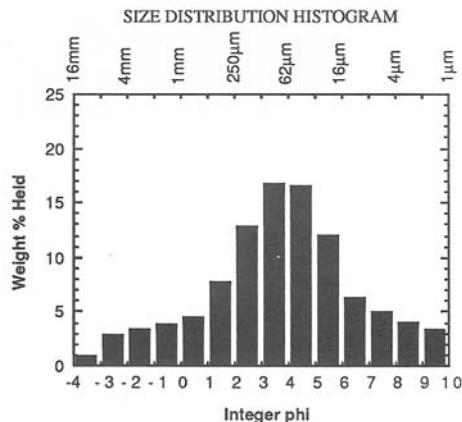


Figure 5a: Grain size distribution of 15500 (Graf 1993).

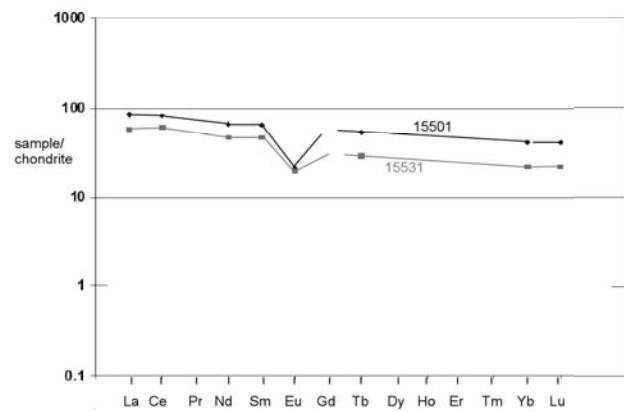
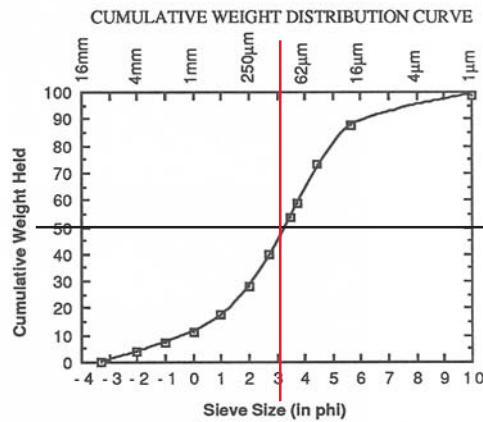


Figure 4: Normalized rare-earth-element diagrams for 15501 and 15531 (Korotev 1987).

Processing

15500, 15510 and 15530 were returned in a sample collection bag (#7) placed in ALSRC#2 (which did not seal).



Average grain size = 102 microns

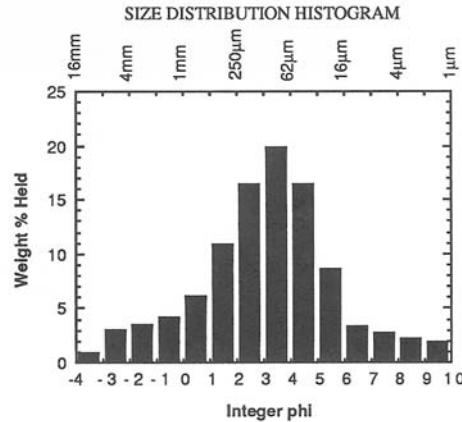


Figure 5b: Grain size distribution of 15530 (Graf 1993).

Table 1. Chemical composition of 15501.

reference weight	LSPET72	Laul72	Morgan72 Ganapathy73	Rancitelli72	Chou74	Duncan75	Korotev87
SiO ₂ %	46.21	(a)				46.46	(a)
TiO ₂	1.81	(a) 1.6	(b)			1.78	(a) 1.78
Al ₂ O ₃	12.2	(a) 12.7	(b)		13.2	(b) 12.54	(a) 12.5
FeO	16.72	(a) 16.5	(b)		16.7	(b) 16.61	(a) 16.8
MnO	0.22	(a) 0.207	(b)		0.22	(b) 0.212	(a) 0.21
MgO	10.8	(a)				10.98	(a) 11
CaO	10.25	(a) 10	(b)		10.4	(b) 10.31	(a) 9.8
Na ₂ O	0.37	(a) 0.377	(b)		0.38	(b) 0.36	(a) 0.37
K ₂ O	0.16	(a) 0.17	(b)	0.15	(d)	0.158	(a)
P ₂ O ₅	0.17	(a)			0.17	(b) 0.184	(a)
S %	0.07	(a)				0.08	(a)
<i>sum</i>							
Sc ppm		31	(b)		34	(b)	32.9
V		139	(b)		220	(b) 129	(b)
Cr	3353	(a) 2942	(b)			3134	(a) 3000
Co			43.6	(c)	50	(b) 50	(a) 48.5
Ni		43	(b) 150	(c)	238	(c) 224	(a) 201
Cu						3	(a)
Zn			14	(c)	13.7	(c) 13	(a)
Ga					4.46	(c)	
Ge ppb			317	(c)	303	(c)	
As							
Se							
Rb	4.7	(a)		4.18	(c)		
Sr	122	(a)				4.8	(a)
Y	72	(a)				115	(a) 120
Zr	317	(a) 370	(b)			67.9	(b)
Nb						312	(a) 330
Mo						19.5	(b)
Ru							
Rh							
Pd ppb							
Ag ppb			30.7	(c)			
Cd ppb			36	(c)	45	(c)	
In ppb			7.4	(c)	35	(c)	
Sn ppb							
Sb ppb			1.51	(c)			
Te ppb			6.2	(c)			
Cs ppm			0.175	(c)			
Ba		120	(b)		230	(b) 220	(a) 195
La		20	(b)		20	(b)	19.9
Ce		53	(b)		55	(b)	50
Pr							
Nd							30
Sm		9.7	(b)		9.35	(b)	(b) 9.56
Eu		0.77	(b)		1.1	(b)	1.17
Gd							
Tb		1.8	(b)		1.7	(b)	1.93
Dy					10	(b)	
Ho							
Er							
Tm							
Yb		6.2	(b)		6.4	(b)	6.7
Lu		1.1	(b)		0.91	(b)	0.99
Hf		7.1	(b)		6.4	(b)	8.1
Ta		0.83	(b)				0.98
W ppb							
Re ppb			0.64	(c)			
Os ppb							
Ir ppb			6.3	(c)	6.3	(c)	5.7
Pt ppb							
Au ppb			2.09	(c)	2.4	(c)	1.3
Th ppm	3.1	(a) 3.4	(b)		4.15	(d) 2.9	(b) 3.4
U ppm		1	(b)		1.03	(d)	(b) 0.89

technique: (a) XRF, (b) INAA, (c) RNAA, (d) radiation count.

Table 2. Chemical composition of 15511

reference weight	Laul 73	Chou74	Duncan75	Korotev87
SiO ₂ %		46.04	(c)	
TiO ₂	1.9	(a)	1.8	(c) 1.8 (a)
Al ₂ O ₃	12.4	(a) 12.5	(a) 12.14	(c) 12.3 (a)
FeO	17.4	(a) 15.8	(a) 16.79	(c) 16.9 (a)
MnO	0.216	(a) 0.23	(a) 0.215	(c) 0.22 (a)
MgO	12	(a)	10.89	(c) 10.9 (a)
CaO	10	(a) 9.4	(a) 10.2	(c) 10.3 (a)
Na ₂ O	0.369	(a) 0.38	(a) 0.35	(c) 0.39 (a)
K ₂ O	0.14	(a) 0.17	(a) 0.153	(c)
P ₂ O ₅			0.193	(c)
S %			0.08	(c)
sum				
Sc ppm	32	(a) 32	(a)	33.1 (a)
V	149	(a) 130	(a) 131	(c) 130 (a)
Cr	3106	(a) 3200	(a) 3168	(c) 3220 (a)
Co	48	(a) 47	(a) 47	(c) 48.1 (a)
Ni		213	(b) 197	(c) 215 (a)
Cu			10	(c)
Zn		14.5	(b) 16	(c)
Ga		4.65	(b)	
Ge ppb		325	(a)	
As				
Se				
Rb			4.9	(c)
Sr			115	(c) 105 (a)
Y			68.7	(c)
Zr	?		319	(c) 300 (a)
Nb			19.9	(c)
Mo				
Ru				
Rh				
Pd ppb				
Ag ppb				
Cd ppb		43	(b)	
In ppb		44	(b)	
Sn ppb				
Sb ppb				
Te ppb				
Cs ppm				
Ba	220	(a) 190	(a) 210	(c) 211 (a)
La	20	(a) 20	(a)	21.6 (a)
Ce	52	(a) 59	(a)	57 (a)
Pr				35 (a)
Nd				10.4 (a)
Sm	9.1	(a) 9.35	(a)	1.23 (a)
Eu	1.3	(a) 1.15	(a)	1.23 (a)
Gd				
Tb	1.9	(a) 1.7	(a)	1.95 (a)
Dy	11	(a) 11	(a)	
Ho				
Er				
Tm				
Yb	6.9	(a) 6.5	(a)	7.2 (a)
Lu	0.98	(a) 0.9	(a)	0.98 (a)
Hf	6.4	(a) 6.5	(a)	8.1 (a)
Ta	1.2	(a)		1.05 (a)
W ppb				
Re ppb				
Os ppb				
Ir ppb		5.8	(b)	6.4 (a)
Pt ppb				
Au ppb		2	(b)	(a)
Th ppm	3	(a) 3	(a)	3.1 (a)
U ppm	0.7	(a)		0.81 (a)
technique: (a) INAA, (b) RNAA, (c) XRF				

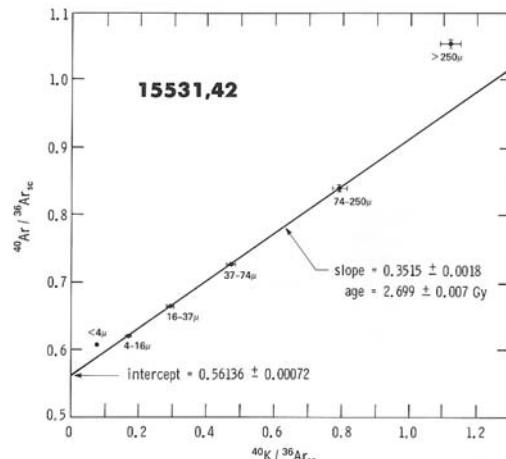


Figure 6: Rare gas in 15531 (Alexander et al. 1976).

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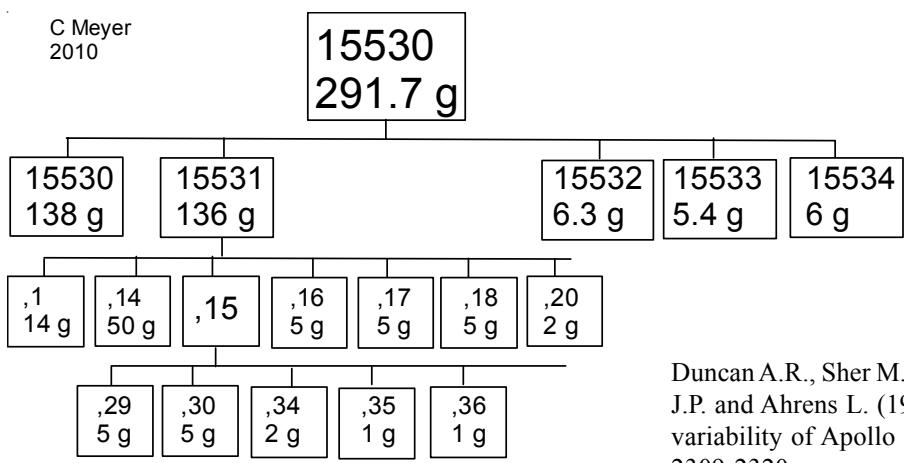
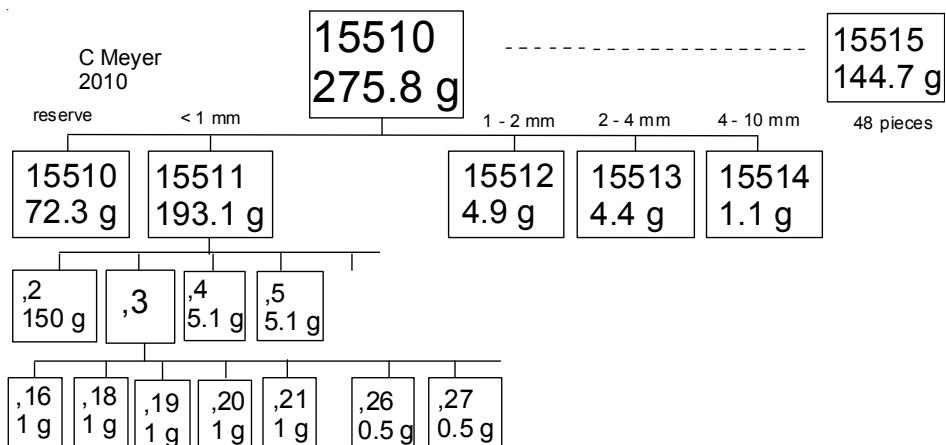
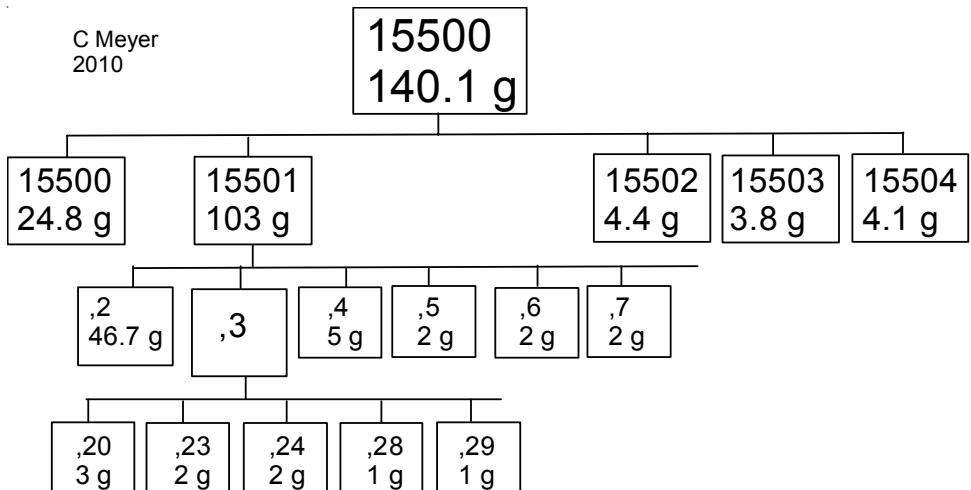
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Table 3. Chemical composition of 15531.

reference	Laul 72	Schnetzler72	Baedecker73	Korotov87	Fruchter73	Wanke73	Murthy72
weight							
SiO ₂ %					46.4		
TiO ₂	2.1	(a)		2.2	(a) 2.2	(a) 2.17	(a)
Al ₂ O ₃	10	(a)		9.9	(a) 10	(a) 9.9	(a)
FeO	19.5	(a)		20.9	(a) 20.7	(a) 20.7	(a)
MnO	0.248	(a)		0.22	(a)	0.25	(a)
MgO				11.3	(a)	11.49	(a)
CaO	10.5	(a)		8	(a)	9.4	(a)
Na ₂ O	0.301	(a)		0.27	(a) 0.29	(a) 0.3	(a)
K ₂ O	0.09	(a) 0.091	(c)		0.09	(a) 0.086	(a) 0.109 (c)
P ₂ O ₅							
S %							
sum							
Sc ppm	36	(a)			40.7	(a) 41	(a) 39.9 (a)
V	182	(a)					
Cr	3353	(a)		3840	(a) 3750	(a) 3810	(a)
Co	50	(a)		55.1	(a) 53	(a) 55	(a)
Ni			145	(b) 183	(a)		
Cu							
Zn			8	(b)			
Ga			3.9	(b)			
Ge ppb			141	(b)			
As							
Se							
Rb		2.24	(c)				
Sr		103	(c)	100	(a)		
Y						2.618	(c)
Zr	130	(a) 173	(c)	200	(a)	104.3	(c)
Nb							
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb		21	(b)				
In ppb		400	(b)				
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm				0.13	(a)		
Ba	110	(a) 117	(c)	149	(a)		
La	10.9	(a) 28.4	(c)	13.6	(a) 12	(a) 11.6	(a) 118 (c)
Ce	35	(a) 19.6	(c)	37	(a)		
Pr							
Nd		5.81	(c)	21	(a)	24	(a)
Sm	5.7	(a) 1	(c)	6.82	(a) 5.7	(a) 5.9	(a)
Eu	1	(a)		1.095	(a) 1	(a) 1.04	(a)
Gd							
Tb	1	(a)		1.05	(a) 1.2	(a)	
Dy		8.06	(c)			8	(a)
Ho						2	(a)
Er		4.67	(c)				
Tm							
Yb	4.8	(a) 4.14	(c)	3.61	(a) 4.2	(a) 3.9	(a)
Lu	0.66	(a) 0.61	(c)	0.534	(a) 0.67	(a) 0.67	(a)
Hf	4.4	(a)		4.1	(a) 4.2	(a) 3.9	(a)
Ta	0.6	(a)		0.57	(a)	0.52	(a)
W ppb							
Re ppb							
Os ppb							
Ir ppb			3.4	(b) 2	(a)		
Pt ppb							
Au ppb			1.8	(b) 1	(a)		
Th ppm	1.8	(a)			1.19	(a)	
U ppm				0.29	(a)		

technique: (a) INAA, (b) RNAA, (c) IDMS



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